

K-186 Part 1

May 6, 1948

REPORT OF SPECIAL CHEMICAL AND PHYSICAL  
URINE ANALYSES FOR FIRST QUARTER, 1948

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CARBIDE AND CARBON CHEMICALS CORPORATION  
MEDICAL DEPARTMENT  
K-25 PLANT

## REPORT OF SPECIAL CHEMICAL AND PHYSICAL URINE ANALYSES FOR FIRST QUARTER, 1948

Compiled by N. H. Ketcham

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Report Number: K-188, Part 1

Date of Issue: May 6, 1948

Title: Report of Special Chemical  
and Physical Urine Analysis  
for First Quarter, 1948

Compiled by: N. E. Ketcham

The results of urine analyses for uranium, alpha activity, fluorides, mercury, and beryllium, obtained during the first quarter of the year 1948, are summarized. Sufficient explanatory comment is included to assist the reader in interpretation of the data in terms of the effectiveness of plant health protection activities.

A small volume of work done for other plants is included in the tabulations, but comment concerning other than negative data is confined to cases involving employees of the K-25 plant.

All analyses were made by the K-25 Laboratory Division.

## I. Fluoride Analyses

At the present time an average of 29 persons are routinely examined each week for possible chronic fluoride exposure. A varying, but considerably lesser number, are also examined for possible fluoride exposure as a result of having reported to the Treatment Room.

Determination of urinary fluoride is generally considered to be an excellent index of chronic fluoride exposure. Considerable evidence is available that urinary fluoride in the order of 2 milligrams of fluorides per liter, or lower, will result in no detectable impairment to health over extended periods of time. The following urine fluoride analyses were obtained.

### January

Total number of analyses	8
Number of analyses below 1.0 mg. F/liter	8

### February

Total number of analyses	141
Number of analyses below 1.0 mg. F/liter	137
Number of analyses between 1.0 and 1.5 mg. F/liter	4

### March

Total number of analyses	92
Number of analyses below 1.0 mg. F/ liter	91
Number of analyses between 1.0 and 1.5 mg. F/liter	1

## II. Uranium Analyses (Chemical)

At the present time an average of 55 persons are routinely examined each week and urine specimens obtained for chemical uranium analyses. An additional lesser number of specimens are taken in connection with Treatment Room visits. As a high percentage of inhaled or ingested soluble uranium salts are eliminated rapidly in the urine, such analyses serve as an index of exposure. By proper scheduling of sampling it is possible to determine if appreciable uranium is "stored"

in the body. Analyses of 0.01 to 0.05 milligrams uranium per liter followed within a few days by analyses of 0.00 milligrams uranium per liter are considered evidence of light single exposure. Analyses of several tenths of a milligram per liter are obtained following exposures of a high order of magnitude.

The following urine uranium analyses were obtained.

January

Total number of analyses	250
Number of analyses of 0.00 mg. U/liter	248
Number of analyses between 0.01 and 0.05 mg. U/liter	2

The two analyses between 0.01 and 0.05 mg. U/liter resulted from known exposures, after which the personnel were sent to the Dispensary. "Follow-up" analyses a few days later were 0.00 mg. U/liter in both cases. One of the patients was a Works Laboratory employee, the other a Research Laboratory employee.

February

Total number of analyses	273
Number of analyses of 0.00 mg. U/liter	269
Number of analyses between 0.01 and 0.05 mg. U/liter	3
One analysis of 0.2 mg. U/liter	1

The analysis of 0.2 mg. U/liter was obtained as a part of a regularly scheduled Industrial Health examination. The alpha count\* on the same specimen was  $3.0 \pm 0.9$  c/min/100 ml. The "follow-up" analysis was 0.00 mg. U/liter, with an alpha count of  $0.3 \pm 0.7$  c/min/100 ml. The patient was an Instrument Division employee.

The three analyses between 0.01 and 0.05 mg. U/liter resulted from known exposures, after which the personnel were sent to the Dispensary. "Follow-up" analyses a few days later were 0.00 mg. U/liter in all three cases. Two of the patients were Process Division employees, and one was Maintenance Division employee.

\* See Section III for comment concerning correlation of alpha counts with chemical analyses.

March

Total number of analyses	187
Number of analyses of 0.00 mg. U/liter	182
Number of analyses between 0.01 and 0.05 mg. U/ liter	5

Four of the five analyses between 0.01 and 0.05 mg. U/liter resulted from known exposures, after which the personnel was sent to the Dispensary. One of these five analyses was on a sample taken as a part of a regularly scheduled Industrial Health examination. "Follow-up" analyses of 0.00 mg. U/liter were obtained in all five cases. Three of the patients were Process Division employees, one was a Maintenance Division employee, and one was an Instrument Division employee.

### III. Uranium Analyses (Alpha Count)

At the present time an average of 48 persons are routinely examined each week and urine specimens obtained for an alpha count. An additional lesser number are taken in connection with Treatment Room visits. Present knowledge indicates that while inhalation or ingestion of alpha emitters should be held at a practicable minimum, urinary alpha counts, resulting from inhaled or ingested uranium, maintained at a level lower than 5 c./min./100 ml. are consistent with good health.

Apparent discrepancies between urinary alpha counts and chemical uranium analyses occur with sufficient frequency to be worthy of mention. In some cases an exposure to enriched material not disclosed by the patient's history may account for an unproportionately high alpha count. Present indications are that alpha counts are considerably less reliable than chemical analyses when normal or depleted material is involved. Further investigation of the correlation between the two methods of analysis is being undertaken by <sup>the</sup> Laboratory Division.

The following urinary alpha counts were obtained.

#### January

Inclusion of urinary alpha counting, on a routine basis, as a part of the medical examination was initiated in January. Eleven specimens were counted. No counts in excess of 5 c./min./100 ml. were obtained on specimens from K-25 employees.

Note: An observation initiated in December 1947, revealed that a Laboratory Division employee for a few days eliminated urine which counted considerably in excess of 5 c./min./100 ml. This count was subsequently reduced to a satisfactory level. A special medical report was made on this case.

February

Total number of alpha counts	37
Number of counts below 2 c./min./100 ml.	35
One count of $3.0 \pm 0.9$ c./min./100 ml.	1
One count of $8.7 \pm 1.2$ c./min./100 ml.	1

The count of  $8.7 \pm 1.2$  c./min./100 ml. was on a specimen from a Maintenance Division employee who had reported to the Treatment Room following a possible exposure in the K-631 Building. That count was accompanied by a chemical analysis of 0.00 mg. U/liter. A "follow-up" count of  $0.4 \pm 0.7$  c./min./100 ml. was obtained. The count of  $3.0 \pm 0.9$  c./min./100 ml. was on an Instrument Division employee specimen previously discussed under part II, February.

March

Total number of alpha counts	89
Number of counts below 2 c./min./100 ml.	88
One count of $2.2 \pm 0.9$ c./min./100 ml.	1

The count of  $2.2 \pm 0.9$  c./min./100 ml. was obtained as the result of a routine industrial health examination. The "follow-up" analysis was  $0.6 \pm 0.8$  c./min./100 ml. The patient was a Process Division employee.

IV. Mercury Analyses

At the present time an average of 11 persons are routinely examined each week and urine specimens obtained for mercury analysis. Occasionally specimens are taken as a result of treatment room visits. Although a diagnosis of mercury poisoning must be reached on the basis of clinical findings other than urine analysis, the presence of 0.1 mg. Hg/liter, or more, is an indication that some exposure has occurred.

The following urine mercury analysis data was obtained.

January

Total number of analyses	69
Number of analyses of less than 0.1 mg. Hg/liter	62
Number of analyses of 0.1 mg. Hg/liter	6
Number of analyses of 0.2 mg. Hg/liter	1

The seven analyses of 0.1 and 0.2 mg. Hg/liter originated as follows.

Three Works Laboratory employees.  
Three Instrument Division employees.  
One Research Laboratory employee.

February

Total number of analyses	68
Number of analyses of less than 0.1 mg. Hg/liter	67
Number of analyses of 0.1 mg. Hg/liter	1

The single analysis of 0.1 mg. Hg/liter was on an Instrument Division employee specimen.

March

Total number of analyses	34
Number of analyses of less than 0.1 mg. Hg/liter	33
Number of analyses of 0.1 mg. Hg/liter	1

The single analysis of 0.1 mg. Hg/liter was on an Instrument Division employee specimen.

A further examination of the data shows an interesting trend illustrative of the success of the combined efforts of employees, supervisors and staff personnel in reducing the level of mercury exposure over the past few months.

Month

Percent of Urine Samples  
Containing 0.1 mg. Hg/liter  
or Greater

October and November	28%
December	12%
January	10%
February	1%
March	3%

V. Beryllium:

At the present time beryllium salts are being handled or beryllium metal processed at only one location in the K-25 plant. One group in the Research Laboratory does such work, and the personnel are examined regularly. The examination includes spectrographic urine analyses for beryllium. At present the lack of knowledge concerning the physiological properties of beryllium and its salts precludes reliable interpretation of the urine analysis data.



The following urine beryllium analyses were obtained. Included are a number of analyses on specimens obtained in the course of examining personnel other than K-25 employees.

January

Total number of analyses	9
Number of analyses of less than 0.01 mg. Be/liter	9

February

Total number of analyses	7
Number of analyses of less than 0.01 mg. Be/liter	7

March

Total number of analyses	1
Number of analyses of less than 0.01 mg. Be/liter	1

K-186 Part 2

July 23, 1948

REPORT OF SPECIAL CHEMICAL AND PHYSICAL  
URINE ANALYSES FOR SECOND QUARTER, 1948

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REPORT OF SPECIAL CHEMICAL AND PHYSICAL URINE ANALYSES  
FOR SECOND QUARTER  
1948

Compiled by N. H. Ketcham

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PLANT RECORDS 1950

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Report Number: K-186, Part 2

Title: Report of Special Chemical  
and Physical Urine Analyses  
for Second Quarter, 1948

Date of Issue: July 23, 1948

The results of urine analyses for plutonium, uranium, alpha activity, fluorides, mercury, and beryllium, obtained during the second quarter of the year 1948, are summarized. Sufficient explanatory comment is included to assist the reader in the interpretation of the data in terms of the effectiveness of plant health protection activities.

It is to be noted that plutonium determinations are included for the first time. A limited number of such analyses will continue to be made as part of the Industrial Health Examination program.

During the second quarter arrangements were made to include audiometric testing in selected cases, as part of the Industrial Health Examination program.

Equipment for determining urine catalase has been received. Catalase determinations will be made to supplement the chemical uranium and alpha counting data. It is not planned to include the results of the catalase tests in the quarterly reports. Although such data is of diagnostic value, it is not specific evidence of uranium exposure.

A small volume of work done for other plants is included in the tabulations, but comment is confined to cases involving employees of the K-25 plant.

With the exception of the plutonium determinations, all urine analyses were made by the K-25 Laboratory Division. The plutonium determinations were performed by the Oak Ridge National Laboratories, Health Physics Division.

## I. Fluoride Analyses

Determinations of urinary fluoride continued to demonstrate the effectiveness of health protection measures. It is to be noted that during the entire first six months of 1948 there have been no urine analyses reaching or exceeding a level of 2.0 milligrams of fluorides per liter. Considerable evidence is available in the literature that the amount of fluoride absorption associated with urinary fluoride in the order of 2.0 milligrams per liter, or lower, will result in no detectable impairment to health over extended periods of time.

The following urine fluoride analyses were obtained during the second quarter of 1948.

### April

Total number of analyses	91
Number of analyses below 1.0 mg. F/liter	89
Number of analyses between 1.0 and 1.5 mg. F/liter	2

### May

Total number of analyses	155
Number of analyses below 1.0 mg. F/liter	147
Number of analyses between 1.0 and 1.5 mg. F/liter	6
Number of analyses between 1.6 and 1.9 mg. F/liter	2

### June

Total number of analyses	131
Number of analyses below 1.0 mg. F/liter	130
Number of analyses between 1.0 and 1.5 mg. F/liter	1

## II. Uranium Analyses (Chemical Determinations)

The detection, in a limited number of cases, of urinary uranium in excess of 0.00 milligrams per liter continued to be associated in a high percentage of cases with known exposure incidents. Data over the entire first six months of the year did not give evidence of any chronic exposure conditions. The data continues to demonstrate that exposures of an order of magnitude well below that associated with health impairment can be detected by urine analyses.

Analyses of 0.01 to 0.05 milligrams uranium per liter followed within a few days by analyses of 0.00 milligrams uranium per liter are considered evidence of light single exposure. Analyses of several tenths of a milligram per liter are obtained following exposures of a high order of magnitude.

The following urine uranium analyses were obtained:

April

Total number of analyses	202
Number of analyses of 0.00 mg. U/liter	190
Number of analyses between 0.01 and 0.05 mg. U/liter	8
One analysis of 0.06 mg. U/liter	1
One analysis of 0.08 mg. U/liter	1
One analysis of 0.10 mg. U/liter	1
One analysis of 0.15 mg. U/liter	1

All of the results of greater than 0.00 mg. U/liter were on specimens obtained from patients reporting to the dispensary following known or suspected exposures. These results were distributed by division as follows:

<u>Result</u> <u>(Mg. U/liter)</u>	<u>Division or</u> <u>Department</u>	<u>"Follow-up" Analysis</u> <u>(Mg. U/liter)</u>
0.01	Process	0.00
0.01	Maintenance	0.00
0.01	Maintenance	0.00
0.01	Maintenance	0.00
0.01	Works Laboratory*	0.00
0.02	Maintenance	0.00
0.03	Works Laboratory*	0.00
0.04	Works Laboratory*	0.00
0.06	Process	0.00
0.08	Maintenance	0.00
0.10	Process	0.00
0.15	Process	0.00

\* Analytical personnel. The source of exposure was a near-by Engineering Development Division operation. No Engineering Development Division personnel were present at that time.

May

Total number of analyses	244
Number of analyses of 0.00 mg. U/liter	237
Number of analyses between 0.01 and 0.05 mg. U/liter	4
One analysis of 0.06 mg. U/liter	1
One analysis of 0.4 mg. U/liter	1
One analysis of 0.6 mg. U/liter	1

Six of the seven analyses of greater than 0.00 mg. U/liter were on specimens obtained from patients reporting to the Dispensary following known or suspected exposures. One of the seven was obtained on a specimen representing a routine Industrial Health Examination. The results were distributed by division as follows:

<u>Result</u> <u>(Mg. U/liter)</u>	<u>Division or</u> <u>Department</u>	<u>"Follow-up" Analysis</u> <u>(Mg. U/liter)</u>
0.01	Process	0.00
0.01	Works Laboratory	0.00
0.01	Works Laboratory	0.00
0.02	Works Laboratory	0.00
0.4	Works Laboratory	0.00
0.6	Works Laboratory	0.06 (followed by 0.00)

June

Total number of analyses	257
Number of analyses of 0.00 mg. U/liter	251
Number of analyses between 0.01 and 0.05 mg. U/liter	5
One analysis of 0.2 mg. U/liter	1

Three of the six analyses of greater than 0.00 mg. U/liter were on specimens obtained from patients reporting to the Dispensary following known or suspected exposures. Three of the six were obtained on specimens representing routine Industrial Health Examinations. The results were distributed by division as follows: (next page)

<u>Result</u> <u>(Mg. U/liter)</u>	<u>Division or</u> <u>Department</u>	<u>"Follow-up" Analysis</u> <u>(Mg. U/liter)</u>
0.01	Maintenance	0.00
0.01	Process	0.00
0.02	Works Laboratory	0.00
0.03	Instrument	0.00
0.04	Works Laboratory	0.00
0.2	Works Laboratory	0.00

### III. Uranium Analyses (Alpha Count)

Urinary alpha counts continue to confirm the conclusion that chronic inhalation or ingestion of uranium has been effectively avoided. Occasional slight elevation of the alpha counts is indicative of light short duration exposures.

It is the objective to prevent exposures to an extent that urinary alpha counts will remain at a practicable minimum. However, present knowledge indicates that urinary alpha activity, resulting from inhaled or ingested uranium, if maintained at a level lower than 5 c./min./100 ml. is consistent with good health.

The following urinary alpha counts were obtained:

#### April

Total number of alpha counts	126
Number of counts below 2 c./min./100 ml.	126

#### May

Total number of alpha counts	161
Number of counts below 2 c./min./100 ml.	160*
* (Includes one count of $1.7 \pm 0.8$ c./min./100 ml.)	
Number of counts between 2 and 5 c./min./100 ml.	1**
** (Count of $2.4 \pm 0.9$ c./min./100 ml.)	

The count of  $1.7 \pm 0.8$  c./min./100 ml. was obtained on a specimen representative of a routine Industrial Health Examination. The count of  $2.4 \pm 0.9$  c./min./100 ml. was obtained on a specimen obtained from a patient who had reported to the Dispensary following a known exposure. The results were distributed as follows:



<u>Result</u> <u>c./min./100 ml.</u>	<u>Division or</u> <u>Department</u>	<u>"Follow-up" Count</u>
1.7 <del>2</del> 0.8	Process	0.5 <del>2</del> 0.7 c./min./100 ml.
2.4 <del>2</del> 0.9	Process	0.0 <del>2</del> 0.7 c./min./100 ml.

June

Total number of alpha counts	212
Number of counts below 2 c./min./100 ml.	212

IV. Mercury Analyses

The continued random appearance of urinary mercury in the order of magnitude of 0.1-0.3 milligrams per liter indicates some exposure is still occurring. However, these exposures are of intermittent nature, and evidence of significant chronic exposure is lacking.

The following urine mercury analyses were obtained:

April

Total number of analyses	27
Number of analyses of less than 0.1 mg. Hg./liter	26
Number of analyses of 0.1 mg. Hg./liter	1

The single analysis of 0.1 mg. Hg./liter was on an Instrument Division employee specimen obtained in the course of a routine Industrial Health Examination.

May

Total number of analyses	55
Number of analyses of less than 0.1 mg. Hg./liter	52
Number of analyses of 0.1 mg. Hg./liter	2
Number of analyses of 0.2 mg. Hg./liter	1

The three analyses of 0.1 and 0.2 mg. Hg./liter were on specimens obtained in the course of routine Industrial Health Examinations. The personnel are employed in the following departments:

Two Research Laboratory employees.  
One Instrument Department employee.

June

Total number of analyses	54
Number of analyses of less than 0.1 mg. Hg./liter	52
Number of analyses of 0.1 mg. Hg./liter	1
Number of analyses of 0.3 mg. Hg./liter	1

The two analyses of 0.1 and 0.3 mg. Hg./liter were on specimens obtained in the course of routine Industrial Health Examinations. The personnel are employed in the following departments:

One Research Laboratory employee.  
One Instrument Department employee.

V. Beryllium

During the second quarter of 1948 the Research Laboratory instituted the use of the spectrographic method of beryllium analysis of the Kettering Laboratory of Applied Physiology, Cincinnati, Ohio. Urinary beryllium is now reported quantitatively to a sensitivity of 0.005 mg. Be/liter (5 ppb). Results in the range 0.001 through 0.004 mg. Be/liter (1-4 ppb) are reported to the Medical Department on a qualitative basis. Lack of knowledge concerning the physiological properties of beryllium and its salts precludes reliable interpretation of the urine analysis data.

The following urine beryllium analyses were obtained:

April (None)

May (None)

June

Total number of analyses	4
Total number of analyses of less than 0.005 mg. Be/liter	4

VI. Plutonium

Starting with June, 1948, a limited number of 24 hour urine specimens, forwarded at monthly intervals to Oak Ridge National Laboratories Health Physics

Division for plutonium determinations, are to be summarized in this report.

Present knowledge indicates that a urinary alpha count, resulting from inhaled or ingested plutonium, not exceeding 3.5 c./min./24 hour specimen is consistent with good health. The analytical procedure used separates plutonium from uranium possibly present, hence the resulting alpha count is specific for plutonium.

The following urinary plutonium alpha counts were obtained:

June

Total number of determinations	8
Number of alpha counts below 0.5 c./min./24 hour sample	8